

preached an annual sermon from the same text. It is certain that the sympathies of the public would be alienated; and if those hearers who are taken to task were to follow consistently the lesson inculcated, they would occupy themselves entirely with objects of pecuniary gain instead of providing the discoveries which our manufacturers are so much in need of, or advancing learning by their contributions to the *Philosophical Transactions*.

W. N. HARTLEY

### Our Future Watches and Clocks

IN reference to the note on this subject in NATURE (p. 36), it appears to me that to any radical change in dial-division there exist many objections, of more or less weight, over and above those already enumerated. In regard to—

(A) *Striking the hours*.—(1) It is said that "public clocks . . . could not go on to twenty-four." The same would apply to private clocks as well, as the higher numbers would be struck during the—to children and many others, sick or well—early hours of sleep, when greater disturbance from house clocks than at present occurs would be quite unendurable. The counter-advocacy of silent house clocks would scarcely meet the case.

(2) The alternative suggestion of "one stroke only at each hour" would do away with one important function of public clocks, that of marking to watchless people the exact hour. Persons abed, lonely watchers, and field-labourers, commonly depend upon the church clock for information which could only be acquired otherwise with much discomfort.

(B) *The 24-division plan*.—(3) That no diminution in "the angular motion of the hand" during any given time should be brought about seems most vital. The time of day is often obtained from far-distant clocks, and is even at present not easy to decipher readily, especially under circumstances of inadequate light or visual power.

(4) Similarly, in the case of any slight looseness in the hands—a commonly-neglected chronometric infirmity—it would be harder than ever to decide at a glance what hour is indicated.

(5) It will be observed that the adoption of this plan would almost necessitate half-minute arcs.

(C) *The double 12-division plan*.—(6) Inasmuch as the presence of two concentric circles of figures of undiminished size would shorten the clear effective length of the hands, the arc subtended by the hourly angle would be diminished by much the same extent as in the previous plan (B 3), and a similar objection would apply.

(7) The presence, in any form, of twenty-four symbols, in addition to the maker's name and the like, in the dial area, especially in ladies' time-pieces, would be eminently confusing, and restrictive of instantaneous decision as to what the time may be.

8. Even if, to obviate all this—a point suggested by the statement that "persons probably pay small attention to the figures"—a single circle of twelve conventional symbols, identical or not, such as a radial arrowhead, were adopted to indicate the a.m. and the p.m. hours in their turn, one would have to undergo the added mental labour of deciding the actual number of the hour.

(9) In any case the introduction of a "o" hour, unless we are to adopt railway phraseology, would be most awkward, and in the "double 12-division plan" the transition at noon and midnight from one circle to the other would not be a simple sequence.

Finally, the question arises whether the now common time-pieces, in which the hands are either replaced or supplemented by a series of peep-holes, wherein the minute, hour, and even week-day for the time being, are consecutively displayed, would not aid the introduction of the twenty-four hour system into rough general use. The main disadvantage of abolishing the hands is that one would lose an actual picture suggestive of the time which will elapse between the present and any point in the near future. For all purposes for which closer chronometric accuracy is required, the above stumbling-blocks to change in dial-division, arising out of the pressing value in ordinary life of the ability to tell the time swiftly, and without undue mental effort, would be swept away.

ERNEST G. HARMER

88, Buckingham Road, N., November 19

As regards the practical question how clocks are to be made to strike if the dial is to show twenty-four hours, I have a suggestion to make.

But firstly, the convenience of beginning the day at midnight is evident, as the early morning hours are those which it is most useful to have indicated to the ear, and our clocks may continue to strike from 1 a.m. to 6 as now.

The inconvenience of having to count any number of strokes above six is so great, and doing it so tedious, that most persons break down in attempting it with a slow-striking clock; and I think that there is a good deal to be said for the system, which obtains in some places where the hours are still reckoned as twenty-four, of beginning afresh at the end of every six hours, and denoting 7 and 13 as 1, &c. This plan would make very little or no change.

But what I wished to suggest is: That clock-makers should make the clocks to beat the strokes in pairs; e.g. two strokes and a rest + two strokes and a rest + one stroke, would be 5. This would be counted as easily as 3. Moreover, there would be no occasion under ordinary circumstances to count the strokes at all; whether the hour was odd or even would be all it was necessary to learn for one to know which hour it was of the twenty-four. One may, for instance, in the morning doubt whether it is 10 or 11, or whether it is 11 or 12, but one rarely doubts whether it is 10 or 12. And on the principle I recommend, the last stroke of the clock being single or double would decide the matter. One would not even have to attend to it. I contend that under the present system it is impossible for a person with only ordinary patience to discover whether a clock strikes 11 or 12.

If you think anything of this suggestion, which I have always thought myself to be a fair solution of a difficulty, I shall be glad if you would insert it in your paper.

R. B.

### Lightning-Conductors

IN the *Edinburgh Review* of last July many of your readers will probably have noticed an article on "Lightning-Conductors," written somewhat strongly from the point of view of an advocate of the apparatus thus popularly designated. Perhaps a few words of comment on this paper from a rather different aspect may not be without interest to those who are able and willing to treat the subject with unprejudiced minds.

In the reviewer's narrative of the history of lightning-rods he omits all mention of Franklin's initial letter of September 1, 1747—that letter in which the great discovery of the power of points is given to the world. But it is abundantly evident from his subsequent letters of 1749 and 1750, in which he definitely forecasts the invention of rods, that it was to his knowledge of this power—and of this power alone—that he owed the idea of these instruments. In other words, his original conception was purely that of an apparatus for preventing the occurrence of a lightning-stroke at the place where the rod was erected. Now, if I am not mistaken, the reviewer from first to last never alludes to this all-important function. It is true that Franklin himself afterwards fell in with the curious supposition that these rods acted as "conductors" of a stroke. But (so far as can be judged from his letters) this was not till September 1753, at which time most of the European scientific men, themselves either ignorant or sceptical of the preventive power of points, had fully adopted the invention and had invested it with the theory, that has ever since been accepted, of its being a means of "conducting" past the building a stream of fiery matter (denoted as "electric fluid") descending from the clouds to the ground. Now it is evident that nothing can conduct the agency known by us as "lightning" without first being struck by it; and it is also manifest that, in order to be so struck, an object must present some "attraction" to the stroke. This attraction—this necessary first step to conduction—allowing for the nonce that an explosion such as constitutes a lightning-stroke can be conducted—is a matter that usually (and not unnaturally) is treated by those who believe in lightning-rods with some little reticence. I therefore think it is but fair to give credit to the reviewer for the open and honourable manner in which he enunciates his views of the true function of lightning-rods. He says (p. 40):—"Conductors provided by engineering art are intended to be struck, but struck in such a manner as to govern the lightning and to render the heaviest strokes harmless." There is no beating about the bush. He admits that his conductors are purposely fixed on a house in order to attract a stroke to that house with the view of afterwards rendering the effects of the explosion nugatory. Now the very essence of the opposition that has been made to the use of these conductors lies in this very fact of

attraction—and in one other fact, which is this. It is absolutely impossible to prove that *any stroke at all* would have occurred at the house if the attractive conductor had not been present. Granted, we (opponents) say, that your conductor, if in good order, *may* be the means of averting the terrific force of the explosion from the non-conducting materials of the building when once the stroke has been developed, we nevertheless prefer that our houses should receive *no stroke at all*. We infinitely prefer to run the extremely unlikely chance of ever being visited by a lightning-stroke to the practice of deliberately inviting such a stroke to our houses, and of trusting to the excellence of the rod-manufacturer's arrangements to avert any portion of its effects from the inmates and the structure.

Holding, then, as we do, that the principle of the lightning-rod, *quod* its necessary exposure of additional elevated metal on a building, is vicious, and that nothing of a beneficial nature due to the preventive power of its point (if it have one) can obliterate this dangerous tendency, the undoubted disadvantages of the system, due to the defects in practice that habitually accompany the employment of rods, appear to be minor points. But the reviewer's reasoning on this branch of the subject is worthy of remark. He says (p. 52): "The failures incident upon defective work—as all unbiased and properly-trained thinkers are aware—are amongst the weightiest of the arguments that tell in favour of the employment of conductors." This sentence is wholly beyond my own reasoning power. Because (*caleris paribus*) an apparatus is liable to failure on account of being defectively constructed, *therefore* it should be employed! He goes on to say:—"In a very large majority of the cases in which accidents have occurred to buildings which have been furnished with lightning-conductors the mischief has actually been traced by competent inquiry to some easily recognised fault or deficiency of construction." Allowing that even in *all* cases in which these disasters had occurred this statement were true, what does it show? Why, simply the very cheap sort of perception known as *wisdom after the event*. The manner in which, after the blow has happened, ingenious excuses are constantly made for the unfortunate conductors, which previous to the event had never been found fault with, is to the opponents of rods one of the most amusing and least edifying circumstances that environ the use of these instruments. But I would now venture to submit a few statistics derived from researches specially made by me during the last five years in regard to strokes and accidents in connection with lightning-rods. Up to date I have collected the fullest details of 320 well-authenticated cases. In 204 of these, or 64 per cent., injuries either to rods, constructions, or persons, occurred. In 151 cases, or 47 per cent., there were injuries either to constructions or to persons. Out of these 151 incidents, 71 contain in their records no allegations as to the existence of faults, either in the rod or in its "earth," until *after the event*, and the remaining 80 furnish no record of such faults being found *either before or after the event*. And indeed the whole of the results of my researches afford evidence (and especially in regard to the "earths" of rods) that failures and accidents more frequently happen with rods in what is deemed good order, than with those considered after the event to have been in bad order.

The reviewer in his enthusiastic advocacy of lightning-rods advises his followers not to be content with single, or even a few, rods on their houses, but to cover them with "a broadly-cast net of metallic meshes and lines." And he concludes with the following sentence:—"The free and frequent use of the testing galvanometer is the natural consummation of the beneficent work which was initiated by Franklin 130 years ago. Without this instrument the lightning-conductor is a hopeful and very generally helpful expedient. But with the galvanometer it is now assuredly competent to take rank as a *never-failing protection*." These *dicta* aptly conform with the reviewer's tactics in respect of the practical question of the *cost* of lightning-conductors. Here again, as in the case of the preventive power of points, he never mentions the subject. He seems to think that persons of common sense are capable of throwing "a broadly-cast net of metallic meshes and lines" of the purest copper over their houses, and of entertaining at frequent intervals the services of electrical testers to attend to these meshes and lines, without first counting the cost. He is perhaps unaware that (according to Sir William Thomson) the Glasgow manufacturers think it cheaper to insure their factories rather than to employ lightning-rods. But surely in regard to the statement that the use of the galvanometer makes the lightning-

conductor a "never-failing protection," there is some little obscurity in the premises and conclusions. It is well known that rod advocates recommend the use of the galvanometer principally in order to test the resistance of the rod's "earth." If this resistance should prove to be above a certain standard, they say that the rod is not only useless, but dangerous. How is the mere fact of the *knowledge* that a rod is useless, or that its earth-resistance is too great, a "never-failing protection"? And what remedial measures can possibly obviate the dryness of the ground? One might as well say that the services of a physician who, having tested his patient's state of health, should tell him that he was in a bad way, and should then dismiss him, constituted a "never-failing protection." In the case of the rod the only protective feature appears to me to lie in the probability that most persons who were also "unbiased and properly-trained thinkers," on being informed that the galvanometer had demonstrated their rods to have a too great "earth" resistance, would immediately pull them down. But obviously this is hardly the reviewer's meaning.

ARTHUR PARNELL

53, Fulham Park Gardens, November 17

### Government Scientific Books

SHORTLY after the commencement of the publication of the "Scientific Results of the Voyage of H.M.S. *Challenger*" by the Government, the late Mr. T. C. Cobbold, M.P. for Ipswich, inquired in the House of Commons whether, inasmuch as this expedition was undertaken with the nation's money for national scientific purposes, a copy of the volumes as published would not be presented to the public libraries supported by public rates, &c. The Government reply was that the expense of supplying the work gratis to such libraries in the different towns throughout the country would be too large.

I should like to ask whether it would have cost anything like the £7,500<sup>l</sup>. which the Government has recently paid for only two pictures from the Blenheim collection, and whether the ratepayers throughout the country have not a far greater right to be supplied (through their libraries) with the opportunity of seeing and studying the results of their own scientific expeditions than the remote opportunity of seeing these two £7,500<sup>l</sup>. paintings at Kensington.

I see by your advertisement that the tenth volume, at 50s., of the "*Challenger Reports*" is just published. What chance have thousands like myself of ever seeing them. Our public museum library cannot afford to purchase them, though I have little doubt but that our town, with its 50,000 inhabitants, has more than paid for a copy of the Reports in its share towards the expense of the Expedition and the publications resulting therefrom.

As a country ratepayer I must protest against this centralisation of all the great works in art and the benefits and results of scientific expeditions in London. Some of your correspondents have complained that such *national publications* are not supplied to great national libraries abroad, but how is it that even we who have had to pay for them cannot ever get a sight of the results of such interesting and important national scientific expeditions. "Cannot afford it" is the Government reply, but how then can they afford £7,500<sup>l</sup>. for two paintings for the national galleries? I do not grudge the expenditure of the people's money for the latter, only when set off against the "cannot afford" for the former.

W. BUDDEN

Ipswich, November 18

P.S.—I have the two volumes of Sir C. W. Thomson's "*Voyage of the Challenger*," but they have only tended to create a greater desire to see the complete "Government Reports," a wish, alas, which, from the expenditure of the £7,500<sup>l</sup>. for pictures by the Government, is further off than ever.

### Peculiar Ice Forms

ABSENCE from town prevented me from seeing NATURE of November 6, in which there is a letter (p. 5) signed B. Woodd Smith with the above heading.

Possibly Mr. Smith's very ingenious explanation of the cause of the columnar form of the shallow stratum of ice he so well describes may be the correct one; yet perhaps I may be permitted to offer a very different solution of the difficulty connected with this very curious ice formation.

I have frequently noticed, both on lakes having deep water